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ABSTRACT

A study investigated children's natural learning of word meanings while reading. Subjects, 447 American and Chinese children in third and fifth grades, read one of two cross-translated stories and then completed a test on the difficult words in both stories. Results indicated: (1) significant incidental learning of word meanings in both grades in both countries; (2) in each country, incidental word learning appeared on both easy and difficult test questions and among children at all levels of ability; (3) for children from both cultures, the strength of contextual support in the stories and the conceptual difficulty of the words affected learning; and (4) the morphological transparency of words influenced word learning among Chinese fifth graders, but not among American children in either grade. Considering the many differences in language and culture between China and America, the findings suggest that incidental acquisition of word meanings while reading is a universal in written language development. (Thirteen tables of data are included; 57 references and English and Chinese target words from the texts are attached.) (Author/RS)

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Center for the Study of Reading

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Abstract

Children's natural learning of word meanings while reading was investigated in a study involving 447 American and Chinese children in third and fifth grades. The children read one of two cross-translated stories and then completed a test on the difficult words in both stories. The results showed significant incidental learning of word meanings in both grades in both countries. In each country, incidental word learning appeared on both easy and difficult test questions and among children of all levels of ability. For children from both cultures, the strength of contextual support in the stories and the conceptual difficulty of the words affected learning. The morphological transparency of words influenced word learning among Chinese fifth graders, but not among American children in either grade. Considering the many differences in language and culture between China and America, the results imply that incidental acquisition of word meanings while reading is a universal in written language development.

INCIDENTAL LEARNING OF WORD MEANINGS WHILE READING: A CHINESE AND AMERICAN CROSS-CULTURAL STUDY

Although direct instruction is widely assumed to be the main source for children's vocabulary development, this assumption has recently been challenged. In the United States, it has been found that children's vocabulary increases rapidly, with an estimated 3,000 or more words added annually between grades three and nine (Nagy & Anderson, 1984; Nagy & Herman, 1987; White, Power, & White, 1989). However, only a small portion could be the result of direct instruction in the classroom (Jenkins & Dixon, 1983).

How can children's vocabulary increase so dramatically? Where does the majority of children's word knowledge come from? In recent years, studies on the acquisition of word meanings have offered new answers to these questions. The research has verified that children are able to learn word meanings incidentally from context during normal reading, and that this is the main source of vocabulary growth (Jenkins, Stein, & Wysocki, 1984; Nagy, Anderson, & Herman, 1987; Nagy, Herman, & Anderson, 1985). However, until now, the conclusion has been drawn from studies done only with American children reading English. The purpose of this research is to extend the study of the acquisition of word meanings to children from a different cultural context, reading a very different language, specifically Chinese children reading Chinese.

Incidental Acquisition of Word Meanings in English

Incidental acquisition of word knowledge from natural context during normal reading is a complicated and only partially understood process. First of all, readers focus mainly on comprehending the text, rarely paying special attention to the meanings of unfamiliar words. Sometimes a passage can be understood well even if quite a few words remain unknown (Anderson & Freebody, 1983). Second, the clues provided in natural texts vary greatly (Carroll & Drum, 1983; Schatz & Baldwin, 1986). Some contexts reveal word meanings, but most reveal partial information at most (Beck, McKeown, & McCaslin, 1983). Third, difficult words that children encounter in natural texts have different degrees of familiarity (Beck, McKeown, & Omanson, 1987; Dale, 1965; Loewenthal, 1971). Words that are completely unknown to some children may be partially known by other children. Thus, children appear to learn new words from different starting points. With such a complicated process, although psychologists and educators have long hypothesized that learning from context through extensive reading might be one of the important sources in children's vocabulary growth (Huey, 1908; Nagy & Anderson, 1984; Sternberg, 1987), solid evidence of this was not forthcoming (Gray, 1938; Sachs, 1943) until recently.

In a 1984 study, Jenkins et al., showed that fifth-grade students could acquire unfamiliar word meanings while reading. However, the texts employed in this study contained more information about the unfamiliar words than is found in natural texts. Furthermore, significant learning from context was evident only when the unfamiliar words appeared repeatedly.

In 1985, Nagy and his colleagues explored incidental acquisition of word meanings from context under conditions more closely approximating natural reading. Seventy average and above average eighth-grade students were asked to read real grade-level texts, in which words that were likely to be unfamiliar had been identified by experienced teachers. Fifteen minutes later, they were tested for their knowledge of the unfamiliar words, first in an interview, then on a multiple-choice test. Both tests were designed to be sensitive to even slight improvements in word knowledge. In this study, a small but significant gain in word learning was obtained. The probability of learning a word while reading was found to be between 15% and 22% on the multiple-choice test.

To reach a more general conclusion, Nagy et al. (1987) examined 352 students in third, fifth and seventh grades, including high-, average-, and low-ability children. In each grade, four texts were selected from grade-level textbooks. There were two narrative texts, one difficult and one easy, and two expository texts, one difficult and one easy. Students were asked to read either two narrative or two expository texts. To examine the long-term effect of learning from context, students were tested on the knowledge of target words from the texts after six days. Significant learning from context was again demonstrated, although the gain (5%) was smaller than that in the prior study.

Using measures sensitive to partial knowledge, other recent studies have confirmed that children are able to learn word meanings incidentally from context (Herman et al., 1987; Shefelbine, 1990; Stahl, 1990). Nonetheless, there is still much to be learned about incidental learning from context, and the factors that might affect it need to be explored further.

Word difficulty is a factor ignored in empirical studies until recently. The unfamiliar words met in natural context present a wide range of difficulty for children. Jenkins and Dixon (1983) and Graves (1984) have classified unknown words into categories in terms of hypothesized difficulty for children's learning. Both classifications treat whether children know the concept associated with a new word as an important index of difficulty.

Nagy et al. (1987) empirically investigated the effect of word difficulty on learning from context. The study showed that the conceptual difficulty of a word is one of the most important factors affecting children's incidental learning from context during reading. When the concept associated with a new word is unfamiliar to children, it is almost impossible for them to learn the word incidentally from context from a single exposure.

Word structure analysis has been suggested as another factor that might help children obtain word meanings during reading (White et al., 1989). In 1984, Nagy and Anderson analyzed the semantic relatedness among morphologically similar words. They found that although most words can be decomposed into root words, prefixes, and suffixes, the degree to which these components indicate the meaning of the whole word differs widely. The meanings of some words can be determined easily based on the word parts with little or no help from context. These are called *morphologically transparent* words. At the other extreme are words for which the components contribute nothing to the meaning, which are called *morphologically opaque* words. Most words fall in between: although their meanings cannot be derived solely on the basis of word parts, their meanings are likely to be clear when they appear in even a moderately helpful context. Nagy and Anderson proposed that, because word structure analysis alone is usually not sufficient to determine the meaning of an unfamiliar word, if children could combine the information from both word structure and context, they would learn word meanings more easily.

Two studies have explored that hypothesis. In Wysocki and Jenkins' 1987 study, children were taught unfamiliar words, then tested on transfer words with stems that were the same as the words they were taught. The words appeared either in a sentence context with strong contextual clues or in a sentence with minimal contextual clues. The results showed that strong context helped students at each grade level, although older students derived more from context than did younger students. Also, older students used morphological information more than younger students for words in weak contexts. But students were not found to combine the two sources of information to learn words better.

A study on incidental learning from context (Nagy et al., 1987) examined the effect of word structure. The target words were rated on a scale of four degrees of morphological transparency: (a) Unanalyzable (e.g., *force*); (b) Has a suffix that indicates part of speech (e.g., *destination*); (3) Can be broken into recognizable parts that contribute at least something to the meaning of the whole (e.g., *earshot*); (d) Meaning of the whole is a compositional function of the meanings of the parts, and meanings of the

parts are likely to be familiar to the reader (e.g., *nonliving*). The results failed to show a significant effect of morphological transparency on learning from context.

Acquisition of Word Meanings in Chinese

There has been no systematic empirical research on the acquisition of word meanings from context in Chinese. However, it is generally accepted by Chinese linguists and psychologists that word structure promotes the acquisition of word meanings. Chinese is a logographic system that uses concrete visual representations of words, in which each character relates directly to its meaning (Liu, 1978; Zhang, 1982). The structure of Chinese almost always gives clues to meaning. In modern Chinese, about 80 - 90% of characters consist of a meaning-based radical and a component that offers a phonetic clue. In most cases, a radical (e.g. [female]) in a character (e.g. [aunt]) indicates the semantic category (female) that the character belong to, but it is impossible to obtain the exact meaning of the character based on only its radical. Furthermore, there are irregular characters in which the radical does not indicate the semantic category.

In Fei and Sun's study (1988), adult readers were asked to rate 665 characters that contained four radicals based on the following indexes: (a) A character whose meaning is directly related to the meaning of its radical was rated as 10; (b) A character whose meaning has no relation to the meaning of its radical was rated as 0; (c) A character indirectly related to the meaning of its radical was rated as 5. The results indicated that four radicals contributed differently to the character meanings, and the average degrees of radical usefulness varied from 2.5 to 6.9. Nevertheless, all four radicals were helpful for deriving parts of the meanings of at least some characters.

Meaning-bearing radicals have long been assumed to provide direct clues to the likely meaning of words and help readers to get word meanings (Hull, 1920; T'sou, 1981). In a pioneering study, Kuo (1923) asked American college students to learn the English meanings of a list of characters containing the same radical. They were then questioned about whether or not they had noticed the radical and if they could derive the radical meaning from the list of meanings of characters with the same radical. For example, the radical that appeared in the list of characters representing *bite, kiss, whistle, cry, sing,* and *bark* means *mouth*. It was found that most students did discover the meanings of the radicals.

In a recent study (Zhang, Zhang, & Peng, 1990), radicals have been found to be helpful for retrieval of word meanings. Subjects were exposed to a set of characters and were asked to decide whether a character was related to a semantic category (e.g. 女 (female)). Two types of characters were investigated. The first type consisted of characters with a radical consistent with the semantic category to which the characters belong. For example, the character 姑 (aunt), with a female radical, belongs semantically to the category female. The distractor here is a character without the female radical that semantically belongs to the same category, such as the character 母 (mother). The second type was characters without the category-indicating radical and which belong semantically to the opposite category. The character 兄 (brother), without the female radical, is such a case. The distractor here is a character with the female radical, semantically belonging to the category 男 (male), such as the character 婿 (son-in-law). The results show that the reaction time for the first type of character was shortest (619 ms), and the time for the second type was longest (849 ms). The study indicated that retrieval of character meanings is facilitated when the radical of a character is consistent with the category of the character, and inhibited when it is inconsistent.

Some researchers (Hatano, 1981; Zhang, 1982) have suggested that the characters contained in compound words may be useful in inferring the meanings of words. For example, children should readily understand the two-character word *cattle-meat* (beef) if they know the characters meaning *cattle* and *meat*. Also, words that contain the same character may form a word family. For example, the character signifying meat can form a large set of words such as *cattle-meat* (beef), *pig-meat* (pork), and

sheep-meat (mutton). This property is helpful for Chinese children's learning of new words and new concepts, at least for learning the words' initial meanings.

Hatano (1981) tested the hypothesis that Chinese words are more understandable than compound words in English. He compared the comprehensibility of 30 unfamiliar Latin- or Greek-derived English technical terms and their Japanese equivalents. Three groups of Japanese undergraduates received the words in Kanji, Kana, or English, and were asked to match the words with their definitions in Japanese. Kana are symbols that represent the syllables of spoken Japanese, while Kanji are the Japanese version of Chinese characters. The students performed better in the Kanji condition than in either the Kana or English condition, and also better than American students tested entirely in English. The study suggested that Chinese characters are superior to other writing systems for representing meaning.

Goals of the Present Study

According to research in developmental psycholinguistics, there are general principles of children's oral vocabulary acquisition (Clark & Berman, 1984; Slobin, 1982). Children with various native languages are all reported to infer from context the meanings of unfamiliar oral words before they learn to read (Clark & Berman, 1984; Zhu & Miao, 1990). However, there has been no evidence that shows whether or not children with different writing systems are able to learn incidentally from written context during normal reading. The present study aims to determine whether or not both American and Chinese children incidentally learn unfamiliar word meanings from written context.

The second goal of this study is to look in more detail at incidental learning from context, contrasting the similarities and differences of children in different cultures using radically different writing systems. Given that some differences among writing systems, such as orthographic symbols and grapheme-phoneme or grapheme-morpheme relations, have been reported to affect word processing of skilled readers (Hung & Tzeng, 1981), it is possible that different writing systems also present beginning learners with different problems of vocabulary acquisition, which would then lead children to develop language-specific strategies (Clark & Berman, 1984; Hung & Tzeng, 1981; Stevenson et al., 1982). However, there has been no research on if, or how, such differences in writing systems affect learning word meanings from context.

Several factors were examined in this study, including characteristics of the children, such as grade, verbal ability, and prior knowledge of the unfamiliar words. In the Chinese part of the study, three additional factors were level of school, family background, and out-of-school reading. Another set of factors consisted of characteristics of the target words and the texts in which they appeared, such as the morphological transparency of the word, the conceptual difficulty of the word, and the strength of contextual support for the unfamiliar word. We expected that some factors might affect the performance of children in the two cultures similarly, whereas others might affect them differently.

The morphological transparency of unfamiliar words is a factor that especially interested us. Previous research has found that, to some extent, word structure analysis contributes to the learning of word meanings, both in English and in Chinese (Freyd & Baron, 1982; Hatano, 1981; Liu, 1978; Nagy & Scott, 1990; Wu, 1989; Zhang et al., 1990). However, English-speaking children have not shown the ability to effectively combine the information from word structure and context to learn new words (Nagy et al., 1987; Wysocki & Jenkins, 1987). According to our analysis, this might be related to the fact that word structures contribute differently to learning of word meanings in the two written languages. The meaning of a morphologically transparent word in English may be obtained based on only word structure, whereas acquiring the exact meaning of a Chinese word, whether it is morphologically transparent or opaque, requires the reader to integrate the information from both word structure and context. Thus, Chinese children might depend on both sources of information in learning new words more than English-speaking children.

The conditions of the study were intended to approximate normal reading. In the data analysis, a mixed factorial repeated measures design and hierarchical regression procedures were used. The experimental design in this study resembled the one used by Nagy et al. (1987), but it was modified slightly to suit the conditions of the Chinese language and education. Research on leaning from context is a new area in China. In fact, this study is one of the first in mainland China to utilize modern theories of cognitive psychology and psycholinguistics, complicated experimental design, and advanced statistics in educational research.

Method

Subjects

The study was conducted in the spring of 1990 in the state of Illinois, U.S.A. and the spring of 1991 in Beijing, China. A total of 487 third- and fifth-grade students from the two countries participated. There were 170 American students from two elementary schools in a small, midwestern town: 85 fifth graders and 85 third graders. To obtain a more stable conclusion in the Chinese part of the study, a larger sample was used. The 317 Chinese students came from four schools in the Beijing region, and included 155 fifth graders and 162 third graders. Two of the schools are rated as being among the best in Beijing, where most of the students come from highly educated families. The other two are schools with a low rating in Beijing, where most of the students in one school come from worker families, and from farmer families in another school. Twenty-four American and 16 Chinese students were absent in one part of the study or could not finish the test, so the data from 447 students were included in the analysis: 146 American students and 301 Chinese students.

Texts

Four grade-level texts were selected from American and Chinese textbooks. Two of the texts were for third graders. One was an American story named *Arthur's Thanksgiving* (Brown, 1985). Another one was a Chinese story named *The Biology Corner and Me* (Shanghai Educational Press, 1983). The other two were for fifth graders. The name of the American text was *The Pushover* (Bedgood, 1989). The name of the Chinese text was *The Young Boy - Run Tu* (People's Educational Press, 1988). All of the texts were narratives. It was assumed that comprehending the American texts would require knowledge familiar to American children, but unfamiliar to Chinese children. Similarly, comprehending the Chinese texts would require knowledge familiar to Chinese children, but unfamiliar to American children. We translated the Chinese texts into English, and the American texts into Chinese. Thus, in total, eight texts were used for the study, four in English and four in Chinese.

Target Words

Five American teachers or researchers were asked to select words in each text which might be unfamiliar to children. The words that at least three persons identified as unfamiliar were included in target words. Words with an SFI lower than 40 were also selected as target words (Carroll, Davies, & Richman, 1971). In total, 16 English target words were selected from each of the third grade texts, and 17 English target words from each of the fifth grade texts (shown in Appendix 1).

As for the Chinese passages, five experienced Chinese teachers from the four experimental schools were asked to select words they thought to be unfamiliar to children. Words identified as unfamiliar by at least three teachers were included. To avoid floor or ceiling effects in the different populations, target words were selected that varied widely in difficulty. Fifteen Chinese target words were selected from each of the third grade texts and the Chinese fifth grade texts, and 14 from the American fifth-grade text. Three types of unfamiliar words were included: (a) unfamiliar words consisting of two new

characters; (b) unfamiliar words containing one new character out of two; and (c) unfamiliar words consisting of two familiar characters (English translations shown in Appendix 2).

Checklist Test

A checklist test was used to examine children's knowledge of target words before reading. Besides the target words, it included nontarget words in the texts; general words which varied from high frequency to low frequency; and pseudowords and nonwords. Children were asked to look through the list of words, and respond *yes* for words they knew and *no* for words they did not know. Items checked *yes* scored 1, and items checked *no* were scored 0. Children's responses to targets were used to examine the effect of prior knowledge on learning from context. The measure of general words was treated as one of the indices of children's ability. To correct for guessing, the following formula was used: the proportion of hits on general words minus the proportion of false alarms on pseudowords and nonwords, divided by one minus the proportion of false alarms on pseudowords and nonwords.

In the checklist for American children, there were 176 randomly ordered words for the third grade and 178 words for the fifth grade, falling into the following categories:

1. Target words: 32 target words were selected from the two third-grade texts, and 34 target words from the two fifth-grade texts;

2. Non-target words: 24 non-target words were selected from the two third-grade texts, and 24 non-target words from the two fifth-grade texts. Only nouns, verbs, adjectives and adverbs were included;

3. General words: 48 general vocabulary words, from high frequency words that almost every child knows to low frequency, which perhaps no child would know, were selected for both grade levels. The SFI range of the English words was from 22.9 to 63.8 (Carroll et al., 1971);

4. Nonwords: 36 nonwords were included, such as *ushom*;

5. Pseudowords: 36 pseudowords were included, such as *birdable*.

Similarly, there were 174 randomly ordered words for the Chinese third graders and 176 words for the fifth graders. Five categories were included:

1. Target words: 30 target words from the two third-grade texts, and 29 from the two fifth-grade texts;

2. Non-target words: 24 non-target words from the two third-grade texts, and 24 from the two fifth-grade texts;

3. General words: 48 General vocabulary words from a word frequency book (Wang & Chang, 1985). The range of word frequency was from 2 to 162 times per million;

4. Nonwords: 36 Nonwords were involved. A Chinese nonword is defined as an impossible combination of characters, such as 者蜈 ;

5. Pseudowords: 36 Pseudowords were included. A Chinese pseudoword means a possible combination of characters but not a real word, such as 倜礼 . Or in a real word, one of the characters is mistakenly replaced by a homophone character, such as 粮直 ;

Multiple Choice Tests

Multiple-choice tests were constructed to measure children's word knowledge after reading. Each word was tested with both an easy and a difficult item. The third-grade test consisted of 64 items (32 target words x 2 levels of difficulty) for American children and 60 items (30 target words x 2 levels) for Chinese children. The fifth-grade test consisted of 68 items (34 target words x 2 levels) for American children and 58 items (29 target words x 2 levels) for Chinese children. Five answers were provided for each item: one correct answer, "don't know," and three distractors. An item was scored 1 when the correct answer was selected, and scored 0 when "don't know" was selected. To correct for guessing, the score was -.33 when one of the distractors was selected.

Two levels of difficulty were provided to make the test sensitive to children's partial knowledge. Question difficulty was controlled by varying the similarity of the correct answer to the distractors: In the easy level, a general category of the word or a synonym was provided as the correct answer. Distractors were definitions of words semantically distant from the target word. It is not difficult for children to select the correct answer if they know even a little about a word. In the difficult level, the exact definition of a word was provided as the correct answer, and distractors included the definitions of words semantically close to the target word. Thus, it would be difficult to select the correct answer unless the child had full knowledge of the word.

Measures of Word and Text Properties

Three word and text properties--morphological transparency, concept difficulty, and contextual support--were rated by experienced teachers or researchers. The rating indices for the properties were aligned to fit the Chinese and English writing systems.

English target words were coded for morphological transparency on a 4-point scale as follows: 4--The meaning of the word is clearly related to the meaning of its parts, and the parts are probably familiar to children. 3--The word can be broken into parts, and the parts contribute something to the whole meaning, but the meaning of the parts might be not familiar to children. 2--The word can be broken into stems, affixes or other parts, but these word parts contribute little to the meaning of the whole word. 1--The word is unanalyzable.

The 4-point morphological transparency scale for Chinese target words was:

4-- The word contains one familiar character that helps children figure out what the word is about, such as 鼓掌. Alternatively, the word consists of unfamiliar characters, which contain familiar radicals helpful for deriving the meaning of word, such as 鹦鹉

3-- Although the new character in a word contains a radical helpful for deriving the word meaning, the radical might be unfamiliar to children, such as 祭祀.

2-- A word consists of familiar characters, but the characters contribute little to the whole meaning, such as 象征. Alternatively, a word consists of new characters containing a radical which contributes little to the meaning of the word, or is misleading, such as 仿佛.

1-- The word consists of unfamiliar characters which are unanalyzable.

To measure conceptual difficulty, target words in both Chinese and English were rated on a 4-point scale:

4-- Children already know the word in their oral vocabulary, but have not seen it in print.

3-- Children know another word with the same meaning, but have not seen this particular word before.

2-- Children do not know either the word or the exact concept, but the meaning of the word involves knowledge and experiences available to children.

1-- Children do not know either the word or the concept, and learning the word would involve learning a new concept.

The strength of contextual support for each target word in both Chinese and English was rated on a 3-point scale as follows:

3-- Directive, that is, rich information about the word meaning is provided in the text, allowing children to easily learn the meaning of the word from context.

2-- General, that is, some information is provided in the text allowing children to learn something about the word, but not enough to learn the exact meaning.

1-- Nondirective, that is, little information about the target word's meaning is available in the text.

For each of the above measures, the median ratings by five trained raters were used as predictors for each target word.

Questionnaire for Out-of-School Reading

In the Chinese part of the study, the amount of out-of-school reading was investigated at the beginning of the spring semester. The children were asked to write down the names of books that they had read during the preceding winter vacation. The amount of out-of-school reading was coded as little (3 or fewer books), average (4 to 7 books), or much (8 or more books).

Procedures and Analysis

All students were randomly assigned to one of three versions of the vocabulary checklist, which were identical except for the order of the items. The checklist was completed one week before the main study. In the main study, children in each class were divided into two groups matched for verbal ability, based on the checklist data and teachers' ratings. Children in the two groups were asked to read different stories. One group read an American story, while the other group read a Chinese story. The vocabulary test that was to follow was not mentioned before or during reading. The multiple-choice test was administered after all children had finished reading and the texts had been collected. The test examined target words from both texts, the text that a child had read and the one that he or she had not read.

Hierarchical regression procedures were used in analyzing the data. The dependent measure consisted of scores on multiple-choice test items for individual children. Independent variables (predictors) included between-subject variables and within-subject variables. Since what we were interested in was within-subject main effects and interactions--that is, incidental learning from context and its interaction with subject characteristics, word properties, and text properties--independent variables were entered into the regression model in the following order: the subject's grand mean was entered first, to remove all of the variance associated with differences between subjects. Within-subject main effects and within-subject by within-subject interactions were entered next. Then, between-subject main effects, between-subject by between-subject interactions, and between-subject by within-subject interactions were entered.

Finally, three-way interactions were entered. The *F*-ratio for each main effect and interaction was calculated off-line by hand, because different error terms were used for between-subject, within-subject effects, and interactions. When calculating the *F*-ratio of a within-subject main effect or interaction, the nominator was the increment in R^2 at the point where the variable entered the analysis, divided by the degrees of freedom of independent variable entered at this step. The denominator was the error term (one minus both the variance associated with within-subject variables and the variance associated with between-subject variables), divided by degrees of freedom of the error term (the number of cases minus the number of the variables that were entered in the model, minus the number of subjects, minus one). Nonsignificant main effects and interactions were deleted from the final regression model.

Results

Although the conditions for the children from the two countries were balanced, it is impossible to equate the difficulty of the texts, the target words, and the test items. Therefore, direct comparisons of Chinese and American children would only invite dubious inferences. In this study, the data of the children from the two countries were analyzed separately, then the patterns of results were compared.

Results for American Children

Table 1 presents the basic regression model for the American children. In this model, within-subject variables are prior knowledge of target words (*yes* or *no* reported on the checklist), difficulty level of questions (easy or hard), and word source (from American or Chinese text). Between-subject variables are ability (from checklist), grade (third or fifth grade), and text read (American or Chinese). The effect of learning from context is the interaction of Text Read by Word Source.

[Insert Table 1 about here.]

The most important finding was the significant effect of Learning from Context ($F(1,9321) = 29.4$, $P < .01$), indicating that children get higher scores when the target words are from the text they read than from the text they did not read. Thus, the results show that the American students did learn words from context. Table 2 gives the mean percent correct on the multiple-choice test of word knowledge for the two texts and two word source conditions. The figures given are the average of the two levels of question difficulty. As can be seen from the table, for both texts, students who had read the text knew more of the difficult words than students who had not read the text. Pooling over the conditions, the average percentage gain in knowledge of unfamiliar words was 5%.

[Insert Table 2 about here.]

Another way of representing learning from context is in terms of the probability that an unfamiliar word will be learned. This is the difference between the proportion of words known by the group that has read the text and the group that has not, divided by the proportion of words not known by students who have not read the text. The number represents the proportion of previously unknown words that were learned by students who read the text. This number represents the proportion of previously unknown words that were learned by students who read the text. For the American children, the probability of learning an unfamiliar word from context was about .10 in this study. This figure is close to that found by Nagy et al. (1985).

Table 1 indicates that the main effect of difficulty level of question was negative and significant ($F(1,9321) = 226.7$, $P < .01$), which indicates that, as expected, children did better at the easier level than at the harder level, and that the multiple-choice test is sensitive to children's partial knowledge of words. The lack of a significant interaction of level of question difficulty with learning from context shows that learning from context occurs at all levels of word knowledge.

The effect of prior knowledge of word meanings was positive and significant ($F(1, 9483) = 450.8$, $P < .01$), indicating that children performed better on words they reported on the pretest as known than on words they reported as unknown. The interaction of learning from context with ability was not significant, which means that children with high and low ability did not show a difference in amount of learning from context during reading. This confirms the results of some previous research (Nagy et al., 1987; Stahl, 1990). However, the significant interaction of Ability X Prior Knowledge X Learning from Context ($F(1,9483) = 47.2$, $P < .01$) suggests that high- and low-ability children learned differently in different conditions. Table 3 shows that low- and average-ability children learned more of the words they checked as known, while high ability children learned equal proportions of known and unknown words.

[Insert Table 3 about here.]

A second analysis examined the relation between learning from context and the morphological transparency of words, in which the within-subject variables were prior knowledge, difficulty level of questions, learning from context (that is, the interaction of Text Read with Word Source), and morphological transparency. The between-subject variable was ability.

No significant interaction of learning from context with morphological transparency of words was found. This implies that American children are not using word structure information to learn word meanings from context more effectively, a conclusion also reached by Nagy et al. (1987) and Wysocki and Jenkins (1987).

In a third analysis, which examined the relation between learning from context and the conceptual difficulty of the target words, the within-subject variables were prior knowledge, difficulty level of questions, learning from context, and conceptual difficulty. The between-subject variable was ability.

Conceptual difficulty significantly affected learning word meanings from context ($F(1,9320) = 5.6$, $P < .05$). Further analysis in terms of orthogonal contrasts showed no difference between words rated 1 or 2 or between words rated 3 or 4, so for the sake of clarity and economy of presentation, the scale was collapsed to two levels, Easy and Difficult. There was a significant difference between the two ($F(1, 9, 320) = 5.6$, $P < .05$). Table 4 indicates that the probability of learning an unfamiliar word with a difficult concept was much smaller than learning a word with an easy concept. This result is similar to the result found by Nagy et al. (1987).

[Insert Table 4 about here.]

The new finding in this study was a significant interaction of Learning from Context X Prior knowledge X Conceptual difficulty ($F(1, 9320) = 10.9$, $P < .01$). Table 5 shows that, compared with other kinds of words, there was a much higher probability of learning words signifying easy concepts when children had prior knowledge of them. A possible explanation is that words with easy concept are ones that children have in their oral vocabulary. In contrast, when children report no prior knowledge of words signifying difficult concepts, the probability of learning them from context is very low.

[Insert Table 5 about here.]

The final analysis with the American data examined learning from context and contextual support. The between-subject variable was ability. The within-subject variables were prior knowledge, difficulty level of questions, learning from context, and contextual support. The three-level contextual support scale was collapsed into two levels, Strong and Weak, since an analysis of orthogonal contrasts revealed no difference between contexts rated non-directive and general. The notable result in this analysis was a significant three-way interaction between Learning from Context X Prior Knowledge X Contextual

Support, which significantly affects learning word meanings from context ($F(1, 9323) = 15.1$, $P < .01$). Table 6 makes this interaction clear. With words for which children have no prior knowledge, learning word meanings depends more on the surrounding context; the probability of learning was much larger for words with strong contextual support than with weak contextual support. But with words for which they have partial knowledge, the probability of learning is fairly high even when contextual support is weak.

[Insert Table 6 about here.]

Results for Chinese Children

Table 7 summarizes the principal analysis of learning word meanings while reading for the Chinese children. The within-subject variables, between-subject variables, and the interactions were almost the same as those in the corresponding model for American children, except the children's ability was rated as high, average, or low by teachers. As in the American analyses, the dependent variable was individual scores on the multiple-choice items. Analyses involving both third and fifth grade included 17,766 lines of data; 9,004 lines were included when analyzing data from the third grade, and 8,762 lines when analyzing data from the fifth grade.

[Insert Table 7 about here.]

The most important result was the significant effect of learning from context ($F(1, 17,448) = 29.7$, $P < .01$). Table 8 shows that, like the American children, Chinese children learned word meanings from context under conditions that approximated normal reading. Chinese children who read the text gained about 4 percent over those who did not read the text. The probability of learning an unfamiliar word from context was about .08. These figures are a little lower than those for the American children. As with American children, the effect of the difficulty level of questions ($F(1,17448) = 687.5$, $P < .01$) was significant; children's performance was higher on easy questions than on hard questions. More importantly, the lack of a significant interaction of level of question difficulty with learning from context shows again that learning from context occurred at all levels of word knowledge.

[Insert Table 8 about here.]

No significant interaction of learning from context with ability occurs in the model. This means that Chinese children of all levels of ability are able to learn some unfamiliar word meanings from context. The same result was obtained with American children.

The main effect of prior knowledge was positive and significant ($F(1, 17448) = 339.6$, $P < .01$). This implies that the checklist for Chinese children is also sensitive to prior knowledge of words. However, different from the result with American children, a significant interaction of learning from context with prior knowledge was found ($F(1, 17,448) = 7.0$, $P < .01$). As can be seen in Table 9, the Chinese children were more likely to learn from context words that they had checked as unknown than words they checked as known.

[Insert Table 9 about here.]

In a subsidiary analysis, we examined the relation between learning from context and morphological transparency of words with Chinese children. The interesting result here was the significant interaction of learning from context with morphological transparency among fifth graders (F (1, 8595) = 9.5, $P<$ .01). Analysis of the components of the interaction using orthogonal contrasts showed that morphology could be represented in terms of two levels, Transparent and Opaque. Table 10 shows that morphologically transparent words were learned better than morphologically opaque words.

[Insert Table 10 about here.]

Among Chinese third graders, conceptual difficulty was found to significantly affect learning word meanings from context ($F(1,8838) = 6.2$, $P < .05$). Analysis of orthogonal contrasts revealed no difference between words coded 1 or 2 or between words coded 3 or 4; therefore, the scale was collapsed into two levels. Table 11 shows that children learned more words associated with easy concepts than words associated with difficult concepts. This result is similar to the one in the Nagy et al., study (1987).

[Insert Table 11 about here.]

A significant interaction of learning from context with contextual support was found ($F(1,17449) = 7.7$, $P < .01$). Analysis of orthogonal contrasts revealed no difference between the nondirective and general contexts which, therefore, were pooled and called Weak contexts. As Table 12 shows, the probability of learning is greater when an unfamiliar word occurs with contextual clues than without contextual clues.

[Insert Table 12 about here.]

A final model examined learning from context by Chinese children as a function of type of school, family background, and out-of-school reading. One significant interaction with learning from context appeared. For fifth-grade children, learning from context interacted with out-of-school reading ($F(1,8595) = 6.0$, $P < .05$). Table 13 shows that children who did a lot of out-of-school reading learned more unfamiliar words from context than the children who did not do as much extra reading.

[Insert Table 13 about here.]

Discussion

The exciting finding of this study is that Chinese children, as well as American children, are able to acquire incidentally word meanings from context during normal reading. Considering the large differences in culture, family socialization, education, and the system of written language, what is remarkable is not that there were some differences between Chinese and American children, but rather how similar the pattern of results is for the children from the two countries. It seems that incidental learning from context may be a universal in the written vocabulary development of children.

Four factors were found to influence vocabulary acquisition in this study. The first factor was the conceptual difficulty of the unfamiliar word. This factor was found to affect incidental learning from context for both Chinese and American third-grade children, a result consistent with previous research (Nagy et al., 1987). Clearly, when learning a new word requires building a new concept, learning from context becomes very difficult. The implication is that learning from context is a process based on children's prior knowledge. If a new word can be connected with children's existing concept system, it is easy to learn. But, when learning a new word requires building a new node in the semantic network, it is less likely that this word will be acquired through one exposure during reading.

The effect of conceptual difficulty suggests that children's oral vocabulary and general world knowledge are the important base for the incidental acquisition of written vocabulary. Considering the fact that children in the 1990s possess a vast number of oral words and rich world knowledge before they learn to read, how to make full use of this basis and promote children's word learning is a problem worth investigating in educational research. Providing materials with a theme familiar to children and containing unfamiliar written words that are, for the most part, in their oral vocabulary seems likely to be important, especially for beginning learners. On the other hand, words signifying difficult concepts

perhaps should be regarded as the object of direct vocabulary instruction with a focus on developing new concepts.

The second factor that influenced word learning was strength of contextual support. Both the Chinese and American data indicated that the probability of learning words surrounded by rich contextual information was greater than for words in less informative contexts. This confirms that children actively search for meaning during reading, and the amount of information in the text is an important source for their reasoning. The American data demonstrate that the effect of contextual support is also related to children's prior knowledge. When children knew nothing about target words, they needed stronger contextual clues to learn the words. But for words somewhat familiar to them, less contextual information was required. This is a new finding that goes beyond studies such as Nagy et al. (1987).

The third factor that affected the acquisition of word meanings was morphological transparency. Since Nagy and Anderson (1984) proposed the hypothesis about the relation of morphological transparency of words and learning from context, there has been no evidence that English-speaking children could combine the two sources of information to improve their acquisition of new words. Similarly, in our study, similarly, no interaction of learning from context with morphological transparency was found among American children. In contrast, a significant interaction was found for Chinese fifth graders, which means that the morphologically transparent Chinese words were learned better than morphologically opaque words. A plausible explanation for the difference is that word components contribute differently to the meaning of a whole word in English and in Chinese. A morphologically transparent English word, in this and previous studies, was defined as one in which the meaning of the whole is clearly related to the meaning of its parts. For example, if a child knows the meaning of *in-* and *decision*, then it would not be difficult for him or her to figure out the meaning of *indecision* from its structure, without even reading. Perhaps, that is why the gain for morphologically transparent words in context was not larger for American children.

In contrast, although Chinese word components usually provide semantic category information, obtaining the exact meaning of a word requires integrating the information from word structure and context, even for morphologically transparent words. For example, the morphologically transparent word 獾猪 (badger) consists of two characters. The first is an unfamiliar character with a radical 犭 which means mammal, and the second is a familiar character 猪 (pig). Children can easily infer that a badger is a kind of mammal based on the word structure, but they cannot discriminate further what kind of the mammal it is without context. The semantic category information provided by Chinese word components is very useful, but unlike English it is seldom sufficient. This explains why Chinese children derived the meaning of morphologically transparent words in context more easily than morphologically opaque words.

Skilled adult Chinese readers report that they rarely use a dictionary when they meet new words while reading. Integrating word structure information and the context clues surrounding an unknown word, they usually figure out the meaning of the new word successfully. This study shows that Chinese fifth graders have this ability. That is, they are able to integrate the two sources of information to learn new words. But it is not clear why a significant interaction of learning from context with morphological transparency did not appear among the third graders. Two possible explanations are, first, Chinese third graders are not able to conduct word structure analysis or, second, they cannot integrate the two sources of information while reading.

The fourth factor that influenced acquisition of word meanings was out-of-school reading. Chinese children who read extensively at home learned many more unfamiliar words than did the children who read less. The probability of learning a word from context for children who did much reading was over three times as great as for the children who did some reading, and over seven times as great as for children who did little or no reading. We did not measure out-of-school reading of the American

children in this study; although, a similar conclusion has been reached in previous research with American children. According to Anderson, Wilson, and Fielding (1988), reading outside of school is a strong predictor of vocabulary growth of American children from second to fifth grade.

Why is out-of-school reading so important for learning from context? Recent research suggests three conditions that promote vocabulary acquisition (Nagy, 1988): (a) encouraging children to integrate new words with their other knowledge; (b) presenting new words repeatedly in context; (c) using new words meaningfully in as many ways as possible. According to schema theory, when children can integrate new words with their preexisting knowledge, it causes better understanding of new words and brings the new information into their existing knowledge system. However, "knowing a word" is not enough for reading comprehension, because children can pay more attention to reading comprehension only if they recognize words automatically (Perfetti & Lesgold, 1979). In order to access word meanings rapidly during reading, the opportunity for children to meet new words repeatedly is necessary. Knowing the definition of word is also not enough for reading comprehension. In order to understand words correctly during reading, children need to use words meaningfully in context. Although these three conditions could be provided in good, direct vocabulary instruction, because children must develop a large vocabulary, only extensive reading can meet the three conditions at the same time.

Two factors are notable because they did *not* significantly influence vocabulary acquisition for either Chinese or American children. First, learning from context did not depend upon ability. This implies that all children, whether high or low in ability, are equally able to learn word meanings incidentally from context. This result is consistent with the result of the study by Nagy et al. (1987). However, it is different from the results of most previous studies, in which high ability children have been found to learn words better than low ability children (cf. Sternberg & Powell, 1983).

We suggest that the discrepancy may be due to the experimental conditions. In most previous studies, children were asked to learn artificial words or very low frequency words. Therefore, most children had no knowledge of the target words before reading and, yet, in these studies the test required rather complete learning. Under these conditions it is not surprising that high ability children learned more words. However, in Nagy et al. (1987) and in our own study, the unfamiliar words were selected from natural texts, and the range of difficulty of these words was wide. High ability children might have more knowledge of words and learn mainly harder words in the text, and low ability children might have less knowledge and learn mostly easier words in the text. But all of the children have the chance to acquire some new words. This is important for psychologists and educators because it means that extensive reading will benefit all children, regardless their abilities.

Second, the nonsignificant interaction of learning from context with difficulty of test questions indicates that learning from context occurs at both easy and difficult levels. Just as with the discussion above, while reading natural texts, children meet words of varying personal levels of familiarity. Although children can rarely learn the complete meaning of an unfamiliar word from context after a single reading, they might improve word knowledge a little bit, building on their personal base. For some words, children go from not knowing the words at all to initial representations of meaning. For other words, they go from knowing partial meanings to fuller knowledge. These small steps of progress can be observed only when a test sensitive to partial knowledge is used.

The conclusion that learning words from context is a gradual, incremental process is consistent with the findings of previous studies (Nagy et al., 1987; Shefelbine, 1990). The similar results obtained with Chinese and American children in this study implies that incremental learning from context may be general for all children.

What is the influence of prior knowledge of words on incidental learning of the words' meanings? Previous findings conflict. In the studies of Nagy et al. (1985) and Shore and Durso (1990), students

learned more words they reported as unknown on the prior test. However, Jenkins et al. (1984) found that students learned better words that they were familiar with. The results in the present study are interesting in this regard. We found that, among American children, high ability children learned better the words that they reported as unknown, but low ability children learned better the words that they checked as known. However, regardless of ability, Chinese children learned better the words that they reported as known.

What underlies these differences? A clear answer seems possible if one makes two assumptions. First, we hypothesize that, as a general rule, partial knowledge increases the likelihood of learning words from context. Second, we hypothesize that Chinese children generally had a strict standard for checking *yes* whereas, among American children, the standard was strict for those of high ability, but much lower for those of average and low ability. In other words, we assume that Chinese children and high ability American children checked a word as known only if they were sure they knew its meaning, while low ability American children were inclined to say *yes* if they thought they knew anything about its meaning.

Our results are consistent with the assumption that low ability American children set a low threshold on the checklist task (see also Anderson & Freebody, 1983). Since they had little knowledge of words they checked as unknown, the probability of learning these words from context was small (.02). At the same time, they had only partial knowledge of many of the words they checked as known; their performance on multiple-choice items testing "known" words was not good if they had not read the text (.43), but the probability that they would learn these words from context was much larger (.17). In contrast, high ability American children set a higher threshold. Since they had much more knowledge about the words they checked as known, they did well (.65) on the multiple-choice test even if they had not read the text, and the probability that they would learn a word checked as known (.13) was actually lower than that of low ability children (.17). However, high ability children had partial knowledge of many of the words they checked as unknown. Therefore, their performance (.31) was not so bad for these words, and the probability that they would learn unknown words from context (.12) was much greater than that of average or low ability children.

The subjects in Nagy et al. (1985) were average and above-average eighth graders, and the subjects in Shore and Durso (1990) were college students. Our conjecture is that the mature, high ability subjects in these studies set strict thresholds when asked to report prior knowledge of words. That is, they checked *yes* only when they had relatively complete knowledge of words, and thus there was less room for incidental learning. Meanwhile, they checked *no* for many words they had partial knowledge of, so the probability of learning these words from context was higher. In the study by Jenkins et al. (1984) study, however, subjects were fifth graders, and very difficult target words were selected. In that study, familiarity of these words was assumed to be provided by "preexposure" of the words, not by children's report. The result that children learned more words for which they had preexposure than words for which they had no preexposure implies that children learn better the words that they are familiar with. Thus, it seems possible to reconcile the apparently contradictory conclusions of previous research.

Turning now to the Chinese children, we hypothesize that most of them, including average and low ability children, set a high threshold for reporting a word as known. Thus, they had partial knowledge of some of the words checked as unknown, and this enabled them to learn a higher proportion of "unknown" words from context than was the case of low or average ability American children.

We had hypothesized that culturally-familiar texts would facilitate the acquisition of word meanings. However, this hypothesis was not confirmed for either Chinese or American children. Perhaps the benefits of culturally familiar text were masked by other factors in the study, or maybe, although there was culture-specific content in the texts, the underlying event sequences were familiar to children from both cultures.

Conclusion and Implications

The major finding of this study was that both Chinese and American children acquire word meanings as a natural byproduct of reading. To be sure, the probability of learning an unknown word was small, 10% for American children and 8% for Chinese children, but these figures are in line with the results from other recent work (Nagy et al., 1987; Nagy et al., 1985; Shefelbine, 1990; Stahl, 1990).

Although the likelihood of learning any one unknown word is small, the cumulative benefit of incidental learning of words while reading can be very large. According to estimates by Anderson et al. (1988), an average American fifth-grade child reads about 1,000,000 words every year, among which he or she might encounter about 16,000-20,000 new words. If a child learns 10% of these new words, then 1,600-2,000 new words would be learned during normal reading each year simply from reading.

The present study strongly suggests that extensive reading could also have a large impact on the vocabulary development of Chinese children. The results show that Chinese children, with different abilities and from different schools and families, were able to learn word meanings incidentally while reading. Thus, the study suggests that extensive reading will promote the written vocabulary development of all children. Particularly, this study shows that morphologically transparent characters and words are easily learned from context. As with skilled adult Chinese readers, fifth-grade Chinese children, especially those who read extensively, can combine information from word parts and clues in the text to learn efficiently new characters and words.

There are many difficulties with vocabulary instruction in elementary schools in mainland China. Children are asked to memorize numerous characters before meaningful texts are introduced. Because vocabulary instruction takes much time and attention, the amount of reading is limited in the classroom. Nor do teachers encourage extensive reading outside of school.

According to this study, incidental learning from context through wide reading might be an important avenue for the vocabulary growth of Chinese children. The suggestion for Chinese teachers, just like for American teachers, is that the best way to help children develop their vocabulary may be to lead them to become independent learners, to let them have more time and opportunities to read, to provide them with suitable reading materials, and to encourage them to read widely.

References

Anderson, R. C., & Freebody, P. (1983). Reading comprehension and the assessment and acquisition of word knowledge. In B. Hutson (Ed.), *Advances in reading/language research* (pp. 231-256). Greenwich, CT: JAI Press.

Anderson, R. C., Wilson, P. T., & Fielding, L. (1988). Growth in reading and how children spend their time outside of school. *Reading Research Quarterly, 23*, 285-303.

Beck, I., McKeown, M., & McCaslin, E. (1983). All contexts are not created equal. *Elementary School Journal, 83*, 177-181.

Beck, I. M., McKeown, M. G., & Omanson, R. C. (1987). The effects and uses of diverse vocabulary instructional techniques. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 147-164). Hillsdale, NJ: Erlbaum.

Bedgood, M. (1989, June-July). The pushover. *Children's Digest, 39*, 372.

Brown, M. (1985, November). Arthur's Thanksgiving. *Cricket, 13*, 7-11.

Carnine, D., Kameenui, E., & Coyle, G. (1984). Utilization of contextual information in determining the meaning of unfamiliar words. *Reading Research Quarterly, 19*, 188-204.

Carroll, J., Davies, P., & Richman, B. (1971). *The American heritage word frequency book*. Boston: Houghton-Mifflin.

Carroll, B. A., & Drum, P. A. (1983). Definitional gains for explicit and implicit context clues. In J. A. Niles & L. A. Harris (Eds.), *Searches for meaning in reading/language processing and instruction* (pp. 158-162). Chicago: National Reading Conference.

Clark, E. V., & Berman, P. A. (1984). Structure and use in the acquisition of word formation. *Language, 60*, 542-589.

Dale, E. (1965). Vocabulary measurement: Techniques and major findings. *Elementary English, 42*, 895-901.

Freyd, P., & Baron, J. (1982). Individual differences in acquisition of derivational morphology. *Journal of Verbal Learning and Verbal Behavior, 21*, 282-295.

Graves, M. F. (1984). Selecting vocabulary to teach in the intermediate and secondary grades. In J. Flood (Ed.), *Promoting reading comprehension*. Newark, DE: International Reading Association.

Gray, W., & Holmes, F. (1938). *The development of meaning vocabularies in reading* (No. 6). Chicago: University of Chicago Publications of Lab Schools.

Hatano, G., Kuhara, K., & Akiyama, M. (1981). Kanji helps readers of Japanese infer the meaning of unfamiliar words. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 3*, 30-33.

Herman, P. A., Anderson, R. C., Pearson, P. D., & Nagy, W. E. (1987). Incidental acquisition of word meaning from expositions with varied text structures. *Reading Research Quarterly, 22*, 263-284.

Huey, E. B. (1908). *The psychology and pedagogy of reading*. New York: Macmillan.

Hull, C. L. (1920). Quantitative aspects of the evolution of concepts. *Psychological Monographs, 28*(123).

Hung, D. L., & Tzeng, O. J. L. (1981). Orthographic and visual information processing. *Psychological Bulletin*.

Jenkins, J. R., & Dixon, R. (1983). Vocabulary learning. *Contemporary Educational Psychology, 8*, 237-260.

Jenkins, J. R., Stein, M., & Wysocki, K. (1984). Learning vocabulary through reading. *American Educational Research Journal, 21*, 767-787.

Kuo, Z. Y. (1923). A behavioristic experiment on inductive inference. *Journal of Experimental Psychology, 6*, 247-293.

Liu, I.-M. (1978). The function of word form and phonetic cues in the acquisition of word meaning. *National Science Council Monthly, 6*, 1089-1098.

Loewenthal, K. (1971). A study of imperfectly acquired vocabulary. *British Journal of Psychology, 62*, 225-233.

McKeown, M. G. (1985). The acquisition of word meaning from context by children of high and low ability. *Reading Research Quarterly, 20*, 482-496.

Miller, G. A., & Gildea, P. M. (1987). How children learn words. *Scientific American, 257*, 94-99.

Nagy, W. E. (1988). *Teaching vocabulary to improve reading comprehension*. Urbana, IL: National Council of Teachers of English.

Nagy, W. E., & Anderson, R. C. (1984). How many words are there in printed school English? *Reading Research Quarterly, 19*, 304-330.

Nagy, W. E., Anderson, R. C., & Herman, P. A. (1987). Learning word meanings from context during normal reading. *American Educational Research Journal, 24*, 237-270.

Nagy, W. E., & Herman, P. A. (1987). Breadth and depth of vocabulary knowledge: Implications for acquisition and instruction. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 19-36). Hillsdale, NJ: Erlbaum.

Nagy, W. E., Herman, P. A., & Anderson, R. C. (1985). Learning words from context. *Reading Research Quarterly, 20*, 233-253.

Nagy, W. E., & Scott, J. (1990). Word schemes: Expectations about the form and meaning of new words. *Cognition and Instruction, 7*, 105-127.

Perfetti, C., & Lesgold, A. (1979). Coding and comprehension in skilled reading and implications for reading instruction. In L. B. Resnick & P. Weaver (Eds.), *Theory and practice of early reading*. Hillsdale, NJ: Erlbaum.

Sachs, H. (1943). The reading method of acquiring vocabulary. *Journal of Educational Research, 36*, 457-464.

Schatz, E., & Baldwin, R. S. (1986). Context clues are unreliable predictors of word meanings. *Reading Research Quarterly, 21*, 439-453.

Shefelbine, J. L. (1990). Student factors related to variability in learning word meanings from context. *Journal of Reading Behavior, 22*, 71-97.

Shore, W. J., & Durso, F. T. (1990). Partial knowledge in vocabulary acquisition: General constraints and specific detail. *Journal of Educational Psychology, 82*.

Slobin, D. I. (1982). Universal and particular in the acquisition of language. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art*. New York: Cambridge University Press.

Stahl, S. A. (1990). Prior knowledge and task variations in learning word meanings from context.

Sternberg, R. J. (1987). Most vocabulary is learned from context. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp.89-105). Hillsdale, NJ: Erlbaum.

Sternberg, R., & Powell, W. (1983). Comprehending verbal comprehension. *American Psychologist, 38*, 878-893.

Stevenson, H. W., Stigler, T. W., Lucker, G. W., Lee, S.-Y, Hsu, Ch.-Ch., & Kitamara, S. (1982). Reading disabilities: The case of Chinese, Japanese and English. *Child Development, 53*, 1164-1181.

T'sou, B. K. Y. (1981). A sociolinguistic analysis of the logographic writing system of Chinese. *Journal of Chinese linguistics*.

Van Daalen-Kapteijns, M. M., & Elshout-Mohr, M. (1981). The acquisition of word meanings as a cognitive learning process. *Journal of Verbal Learning and Verbal Behavior, 20*, 386-399.

Werner, H., & Kaplan, E. (1952). The acquisition of word meanings: A developmental study. *Monographs of the Society for Research in Children Development, 15*.

White, T. G., Power, M. A., & White, S. (1989). Morphological analysis: Implications for teaching and understanding vocabulary growth. *Reading Research Quarterly, 24*, 283-304.

Wysocki, K., & Jenkins, J. (1987). Deriving word meanings through morphological generalization. *Reading Research Quarterly, 22*, 66-81.

References in Chinese

Fei, J. C., & Sun, M. J. (1988). Exploration of the degree of radical's contribution to word meaning. *The papers from the conference of Chinese language*. Language Press.

People's Educational Press. (1988). Run, Tu. In *Language textbooks for sixth graders*. People's Educational Press.

Shanghai Educational Press. (1983). The biology corner and me. In *Reading materials for third graders*. Shanghai Educational Press.

Wang, H., & Chang, B. R. (1985). *Analysis of Chinese word frequency*. Foreign Language Teaching and Research Press.

Wu, T. P. (1989). The properties of Chinese character in improving language learning. *Chinese Culture, 1*, 34-37.

Zhang, J. J., Zhang, H. C., & Peng, D. L. (1990). The recovery of meaning of Chinese characters in the classifying process. *Acta Psychologica Sinica*, 139-144.

Zhang, W. G. (1983). Analysis of characters which appear in the textbooks of elementary school. *Educational Research, 5*, 61-69.

Zhang, Z. G. (1982). *Modern Chinese*. People's Educational Press.

Zhu, M. S., & Miao, X. C. (1990). *Psycholinguistics*. South-east Normal University Press.

Table 1

Within-Subject Hierarchical Regression Analysis of Word Learning by American Children

Variable	Beta	Percentage of Variance	F
Grand Mean	.94	9.65	1123.2**
Prior Knowledge (a)	.07	3.84	450.8**
Difficulty Level of Question (b)	-.16	1.95	226.7**
Word Source (c)	.20	0.61	71.5**
Ability	-.03	0.02	2.1
Grade	-.02	0.02	2.1
Text Read (d)	-.02	0.00	0
Ability x Prior Knowledge	.22	0.29	33.5**
Grade x Word Source	-.04	0.41	47.4**
Learning from Context	.04	0.25	29.4**
Word Source x Ability x Prior Knowledge	-.05	0.28	32.9**
Text Read x Ability x Prior Knowledge	.03	0.05	6.2**
Learning from Context x Ability x Prior Knowledge	-.06	0.41	47.2**
Constant/Residual	.26	82.10	

Note: Critical values F (1, 9321) = 6.63, $P < .01$; F (1, 9321) = 5.38, $P < .05$.
(a) coded +1 for yes, 0 for no,
(b) coded +1 for easy question, 2 for hard questions,
(c) coded +1 for words from American text, -1 for words from Chinese text,
(d) coded +1 for read American text, -1 for read Chinese text.

Table 2

Percentage of Words Known by Text Student Read and Word Source for American Children

	Text Read	
Word Source	**American**	**Chinese**
American	49	43
Chinese	32	38

Table 3

Learning of Unfamiliar Words by American Third and Fifth Graders as a Function of Prior Knowledge and Ability

Prior Knowledge/Ability	Read	Not Read	Gain	Probability
Known				
High	.69	.65	.04	.12
Middle	.66	.59	.07	.17
Low	.53	.43	.10	.17
Not known				
High	.31	.22	.09	.12
Middle	.23	.16	.07	.08
Low	.15	.13	.02	.02

Table 4

Learning of Unfamiliar Words by American Children as a Function of Conceptual Difficulty

Conceptual difficulty	Read	Not Read	Gain	Probability of learning
Easy	.48	.40	.08	.15
Difficult	.41	.37	.04	.07

Table 5

Learning of Unfamiliar Words by American Third and Fifth Graders as a Function of Conceptual Difficulty and Prior Knowledge

Prior Knowledge/ Conceptual Difficulty	Read	Not Read	Gain	Probability
Known				
Easy	.67	.56	.11	.22
Difficult	.60	.55	.05	.10
Not Known				
Easy	.23	.15	.08	.10
Difficult	.20	.18	.02	.02

Table 6

Learning of Unfamiliar Words by American Third and Fifth Graders as a Function of Contextual Support and Prior Knowledge

Prior Knowledge/ Contextual Support	Read	Not Read	Gain	Probability
Known				
Strong	.67	.56	.11	.25
Weak	.58	.65	.07	.17
Not Known				
Strong	.28	.10	.18	.20
Weak	.20	.10	.03	.04

Table 7

Within-Subject Hierarchical Regression Analysis of Word Learning by Chinese Children

Variable	Beta	Percentage of Variance	F
Grand Mean	.92	15.41	3414.6**
Difficulty Level of Question	-.18	3.10	637.5**
Prior Knowledge	.17	1.81	339.6**
Word Source	.05	0.38	83.8**
Word Source x Difficulty Level of Question	-.06	0.32	71.5**
Ability (a)	-.02	0.01	< 1
Text Read	.01	0.00	< 1
Learning from Context	.03	0.13	29.7**
Learning from Context x Prior Knowledge	-.02	0.03	7.0**
Constant Residual	.25	78.75	

(a) Coded 3 for high ability, 2 for average and 1 for low ability

Table 8

Percentage of Words Known by Text Read and Word Source for Chinese Children

	Text Read	
Word Source	**American**	**Chinese**
American	60	55
Chinese	49	52

Table 9

Learning of Unfamiliar Words by Chinese Children as a Function of Prior Knowledge

Prior Knowledge	Read	Not Read	Gain	Probability
Known	.65	.63	.02	.05
Not known	.47	.41	.06	.10

Table 10

Learning of Unfamiliar Words by Chinese Fifth Graders as a Function of Morphological Transparency

Morphology	Read	Not Read	Gain	Probability
Transparent	.57	.48	.09	.16
Opaque	.69	.69	.00	.01

Table 11

Learning of Unfamiliar Words by Chinese Third Graders as a Function of Conceptual Difficulty

Conceptual Difficulty	Read	Not Read	Gain	Probability
Easy	.56	.52	.04	.09
Difficult	.35	.34	-.01	-.02

Table 12

Learning of Unfamiliar Words by Chinese Third and Fifth Graders as a Function of Contextual Support

Contextual Support	Read	Not Read	Gain	Probability
Strong	.58	.53	.05	.11
Weak	.53	.52	.01	.02

Table 13

Learning of Unfamiliar Words by Chinese Third and Fifth Graders as a Function of Amount of Out-of-School Reading

Amount of Reading	Read	Not Read	Gain	Probability
Much	.76	.66	.10	.30
Average	.58	.54	.04	.09
Little	.49	.47	.02	.04

Appendix 1

English Target Words From the Texts in Two Grades

Grade	Text	Culture	Total Words	Target Words
3	Arthur's Thanksgiving	American	625	cranberry, fumbling, director, symbol, disaster, glare, braid, announce, auditorium, glamorous, script, narrator, rejoicing, grumble, onstage, PA system
3	The Biology Corner and Me	Chinese	558	various, experience, observation, urgently, cocoon, tadpole, biology, withered, mulberry, cautiously, silkworm, narcissus, bystander, funeral, mishap, compliment
5	The Pushover	American	829	suspicious, helium, vigorously, quiver, frantically, deafeningly, legging, indecision, sidestep, grope, loafer, curbing, mumble, goof about, stagger, carousel, nightmare
5	The Young Boy-Run, Tu	Chinese	874	horizon, badger, Buddha, ancestor, obligated, sacrifices, slingshot, blighted, exhilarated, leap month, ferocious, vow, hedgehog, crafty, inexhaustible, hazardous, exotic

Appendix 2

Chinese Target Words From the Texts in Two Grades (in Chinese)

Grade	Text	Culture	Characters	Target Words
3	Arthur's Thanksgiving	American	995	hold one's breath (bing xi), sail (hang xing), symbol (xiang zheng), cafeteria (can ting), recite (bei song), complain (bao yuan), terrible (zao gao), braid (bian zi), doubt (yi wen), pilgrim (yi min), curtain (mu), director (dao yan), great (sheng da), costume (zhuang shi), fumbling (cao za)
3	The Biology Corner and Me	Chinese	932	enjoy (xin shang), tadpole (chan chu), sometime (ceng jing), sleep (mian), fragmentary (can), secret (ai mi), stem (jing), cautiously (xiao xin yi yi),joy (xi yue), explore (tan suo), withered (gan ku), take care of (zhao gu), shed (tui), mishap (shi gu), funeral (zang li)
5	The Pushover	American	1388	surprise (cha yi), balance (ping heng), helium (hai), lean (yi), stagger (lie qie), helplessly (tu lao), mumble (gu nong), character (mo te), indecision (you yu bu jue), match (pi pei), employee (gu yuan), goof about (xian guang), sandwich (san ming shi), instantaneous (shun jian)
5	The Young Boy-Run, Tu	Chinese	1204	shallow basket (shu bian), felt hat (shan mao), be alike (fang fu), sacrifices (ji si), tie up (fu), leap month (run yue), tide (chao xun), badger (huan zhu), slingshot (qong), blighted grain (bi gu), hipbone (kua), offering (gong pin), serious (sheng shong), crafty (ling li), pigeon (bo gu)